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15 Avian Resources and their Perching Strata: A Basic Field Study from Three Himalayan Hamlets of West Bengal

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Abstract

Studying biodiversity with a conservation approach is a novel attribute for any ecologist. In the following study three different hamlets namely Latpanchar, Simring Tea Estate and Shivkhola from foothills of the Himalayas were selected, based on varying altitude from November 2017 to January 2018. Total 118 species of birds were observed during the study period and perch wise primary preferences of birds were also constructed. The perching height of observed birds were varying in nature, where most of the bird selected upper (>15 feet) and middle (6-15 feet) perching zone. This selection may depend on searching for resources along with their preference over canopy cover. Around 9% of the observed birds were Schedule I species under Wildlife (Protection) Act, 1972 and the study area was dominated by local anthropogenic pressure like tourisms. It would be a serious concern regarding the conservation of such threatened bird species to maintain ecological resilience. Thus, the present work developed a baseline field based data on

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birds in three different habitats from Terai hills of North Bengal with relative perching strata that will help in the ornithological studies from the Eastern Himalayan pockets in near future.

Keywords: Birding, Tea Estate, Eastern Himalayas, Perching, Terai, North Bengal.

Introduction

Darjeeling hills in state of West Bengal from India are an important bio-diverse zone with respect to ecological perspective. After formation of the GTA (Gorkhaland Territorial Administration) and the global Sustainable development goal, this place is one of the most visited eco-tourist spots of West Bengal. The major cash crop, tea is a source of income of the local residents and in seasons, oranges are an agro-product which sustains the local livelihood. Several previous works regarding the ecosystem services of the Mahananda Wildlife Sanctuary (MWLS)and floral components of Darjeeling and Kurseong hills were well documented (Chettri *et al.*, 2018; Zaman & Pramanick, 2020).The vulnerability of the geo-morphological structure of the hills and the floral components with edaphic factors makes this place an abode for Himalayan wildlife. The natural forest near the Mahananda Wildlife Sanctuary (MWLS) outskirts falls under Middle hill forest (above 800 meters msl) dominated by *Betula alnoides, Erythrina arborescens, Accrocarpus fraxinifolius*, large patches of Choya bamboo, thick undergrowth comprises of *Polygonum molle, Desmoedium sp., Girardiana sp.* The ferns and epiphytes are very common. Some grass species namely- *Phragmites karka, Saccharum munja* etc. are found in this area (Zaman & Pramanick, 2020). According to the existing classification of bio-geographic regions of India, the MWLS forest falls in zone 7, *i.e.*, Gangetic plains, Province B (Lower Gangetic Plains), Sub-division Bengal Dooars. Conversion of the higher hills into tea estates and cinchona plantations has fragmented the ecological boundary in the North (Zaman & Pramanick, 2020). While shade trees are important for tea shrub growth, such as, *Schima wallichii, Cryptomeria japonica, Albizia procera, Alnus nepalensis, Syzygium nervosum, Exbucklandia populnea, Eurya japonica* etc. these and mixed bamboo groves are

excellent hiding places for birds and small mammals which are found in and around the tea gardens.

The present study focuses on the diversity of avian fauna of some selected hamlets of Darjeeling hills. Native birds offer a vital ecosystem service to any landscape, by maintaining food chain, food web and forest regeneration, both directly and indirectly. Latpanchar is one of the most popular places of attraction for birders in West Bengal. As it is well known that wildlife sanctuary or a typical riverbed is a non-disturbed zone for wildlife, but in comparison, tea estates are the place where anthropogenic disturbances create interference for the wildlife. The observers here took two another such places for birding- Simring Tea Estate and Shivkhola River bed beside Mahananda River (a riparian ecosystem, locally called- Mahanadi). The diverse floristic components sustain the avian fauna in that region. All the three different habitats of the forest ecosystem are preferred by the birds with respect to time and space. Some birders documented the vertical stratification of birds with reference to foliage in different elevation/vegetation zones in the Eastern Himalayas of Sikkim, India but not in this zone yet (Acharya & Vijayan, 2017).

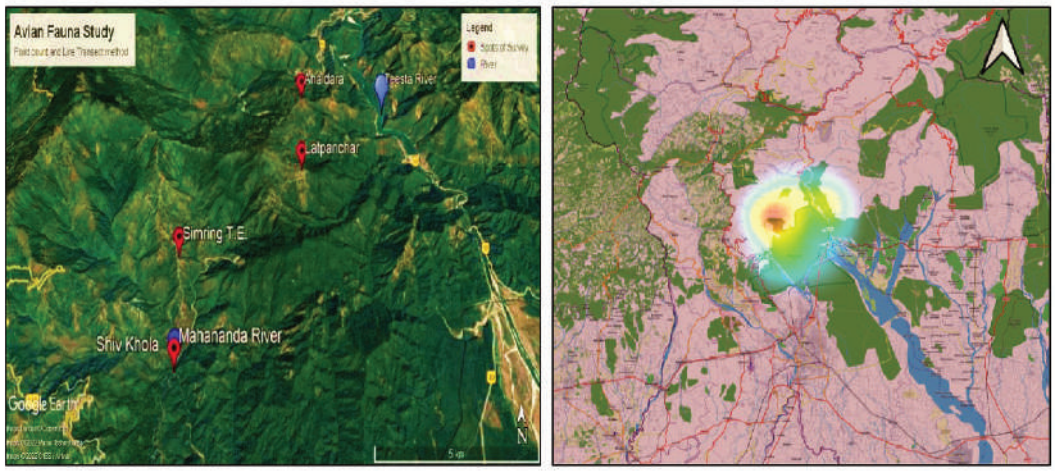

Figure 1: Study area (left) and elevation profile (right) of sampling sites in Darjeeling. The maps were generated using Google Earth Pro and QGIS software.

Materials and Methods

Study Area

The field survey was done in the district of Darjeeling, West

Bengal, India. Three major places of birding were chosen as per convenience of the field observers, namely- Latpanchar (26°54′44.73″N, 88°24′19.05″E), Shivkhola (26°51′48.16″N, 88°21′39.43″E) and Simring Tea Garden (26°53′18.87″N, 88°21′34.06″E) (Figure1). River Teesta lies in the eastern portion and the Mahananda (locally called Mahanadi) river flows in the western portion of the study area. The area is adjoining to the Mahananda Wildlife Sanctuary (MWLS) of West Bengal.

Study time

The study was conducted during the winter months (November, 2017 to January, 2018). The observer groups selected morning slot (05.00 am to 09.00 am) and afternoon slot (3.00 pm to 4.00 pm) for bird watching because during this span, activities of the hill birds are relatively higher than the rest of the day.

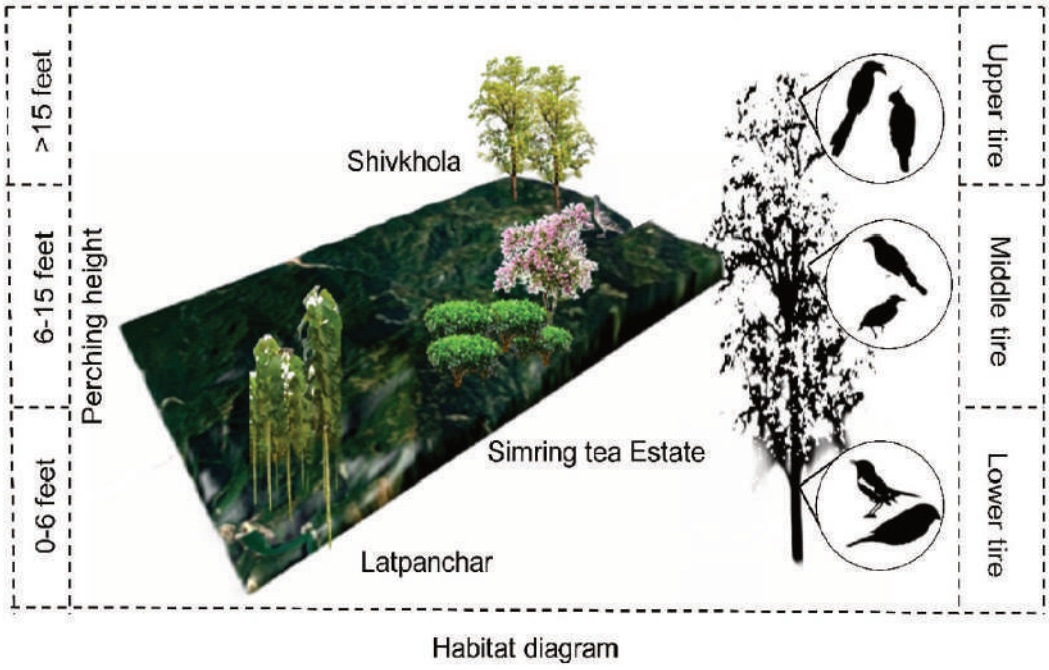

Figure 2: Representative diagram of habitat preference and tree tire occupancy of observed birds from three different sites.

Study Methods

Point count and line transect methods were followed to record the presence of the species in three different locations. Both methods were used to increase sighting opportunity of birds as point count with transect increase data reliability (Altmann,

1974; Sutherland,2006).Like any standard point count method on field the observers gathered data for 5 minutes at each point by scanning the 360° around with an approximate radius of 50 meters. Birds were observed directly by using field binoculars (Olympus 7x21 PS III, Nikon Aculon A211 12 X 50) and photographs were taken using cameras whenever and wherever necessary (Nikon Coolpix S9900 Optic30X, Nikon Coolpix L320). Identification of the birds was done using standard pictorial field guide books (Ali, 2002; Grimmett *et al.*, 2016). Structure of the forest bird community depends on the habitat preference and interaction with other members (Cody, 1985; Wiens, 1989) with respect to time and space. Relative perching heights of the observed birds (Figure 2) were calculated in three different locations of birding, by using Range finders (MacArthur, 1958). Study area map was created using QGIS and Google Earth Pro software.

Data Analysis

Graphical presentations and basic computational studies were carried out by using MS-Excel 2007® and GraphPad Prism 8. Relative diversity (RDi) of different avian families was calculated using the following formula (La Torre-Cuadros *et al.*, 2007):

RDi = (Number of species in a family/ Total number of species) × 100 .... (i)

The IUCN conservation status of recorded birds was taken from the current digital checklist of IUCN (IUCN 2019). Conservation status of the recorded birds was followed by the Wildlife (Protection) Act, 1972 of Government of India (WPA, 1972). Whittaker beta diversity test was used to compare the zone-wise

avian diversity of Darjeeling Himalayan Hamlets.

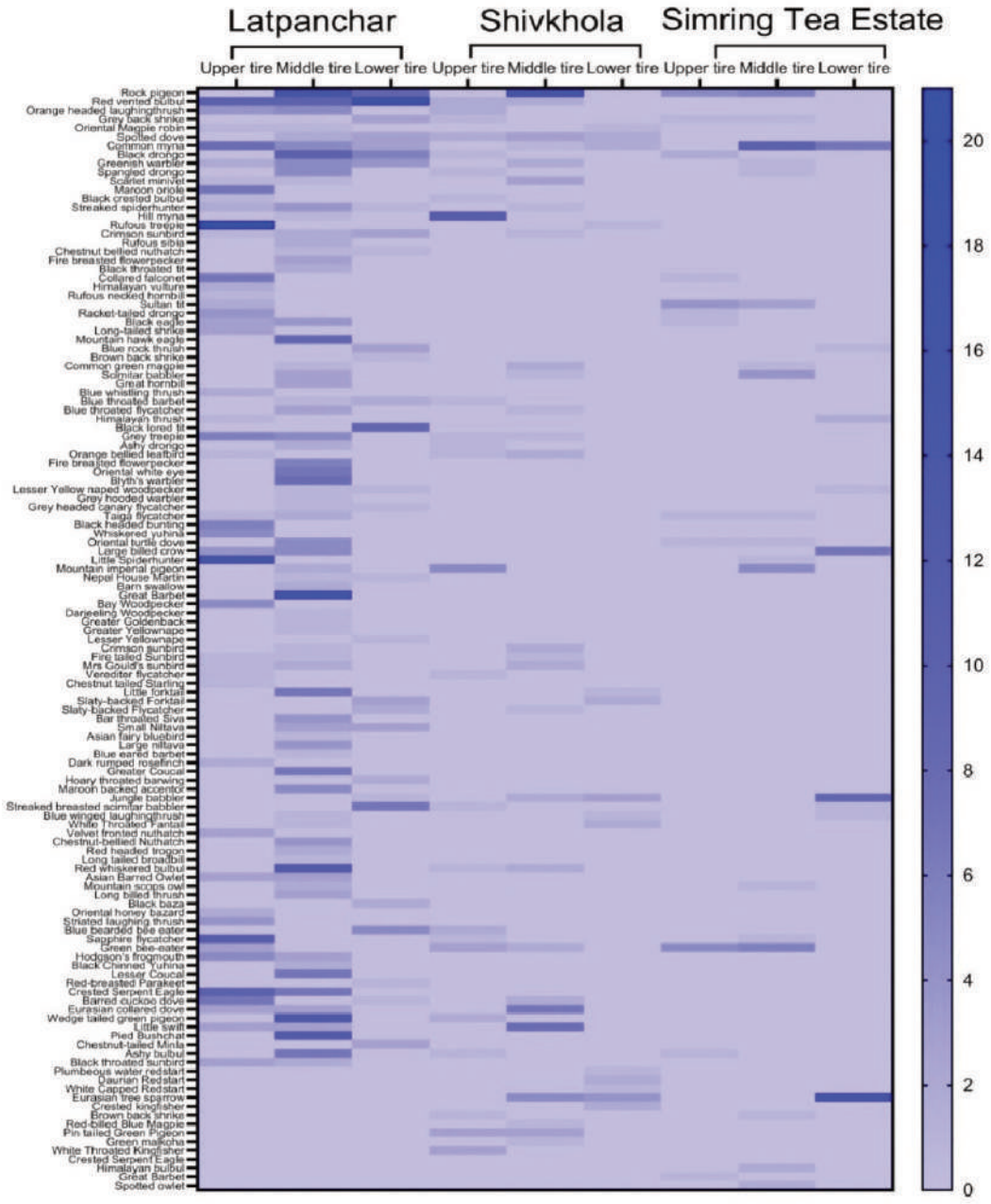

Figure 3: Heat map based on species abundance of different birds in three different locations along with their perching strata.

Results

A total 118 species of birds belongs to 42 families and 13 orders were observed during the study period. The annotated checklist is shown in the Table 1. Analysis of field data on relative diversity (RDi) showed that, Muscicapidae was the most diverse avian family present in the study areas (15 species,

RDi = 13.392) followed by Columbidae (8 species, RDi = 7.142), Accipitridae; Nectariniidae; Leiothrichidae (6 species in each, RDi = 5.357), Picidae; Corvidae (5 species in each; RDi = 4.464), Strigidae; Dicruridae; Pycnonotidae (4 species in each, RDi = 3.571), Cuculidae; Ramphastidae; Phylloscopidae; Zosteropidae; Sturnidae (3 species in each, RDi = 2.678), Bucerotidae; Meropidae; Alcedinidae; Laniidae; Paridae; Hirundinidae; Sittidae; Turdidae (2 species in each, RDi = 1.785), while rest of the families namely, Phasianidae; Podargidae; Apodidae; Trogonidae; Falconidae; Psittaculidae; Campephagidae; Oriolidae; Rhipiduridae; Dicaeidae; Irenidae; Prunellidae; Passeridae; Fringidae; Emberizidae; Stenostiridae; Aegithalidae and Timaliidae represented by only a single species in each (RDi = 0.892) (Table 2).

Wildlife protection is the most important work for any conservationist, for this, the birds were categorized as per WPA, 1972. Among the observed avian species 9% of the observed birds were conserved under Schedule I, 90% Schedule IV and 1% are not listed under Wildlife (Protection) Act, 1972 of Govt. of India. Important to note that, in the study area Rufous-necked Hornbill is a notable Schedule I species under Vulnerable Status of IUCN.

The perching strata of the birds were noted and categorized into three different tiers- upper tier (above 15 feet), middle tier (6-15 feet) and lower tier (0-6 feet). Thereby, a heat map was constructed according to the relative abundance of the species in three different locations (Figure 3). Some of the studied bird photographs are attached in Figure 4.

Sampling site pair-wise beta diversity test (Whittaker beta diversity test) were performed along with three different study sites, the results are, LTPN-SVKL (0.601), LTPN-SMTE (0.720) and SVKL-SMTE (0.440), which interpret that the observed avian communities' in between Latpanchar and Simring Tea Estate are markedly different in terms of avian assemblages during the study period (Table 3). Whereas the avian community of Shivkhola and the Simring Tea Estate are quite similar in terms

of pair wise combination.

Table 3: Whittaker beta diversity index matrix based on bird abundance between three study site from Himalayan Hamlets of West Bengal.

	Latpanchar (LTPN)	Shivkhola (SVKL)	Simring Tea Garden (SMTE)
Latpanchar (LTPN)	-	0.601	0.720
Shivkhola (SVKL)		-	0.440
Simring Tea Garden (SMTE)			-

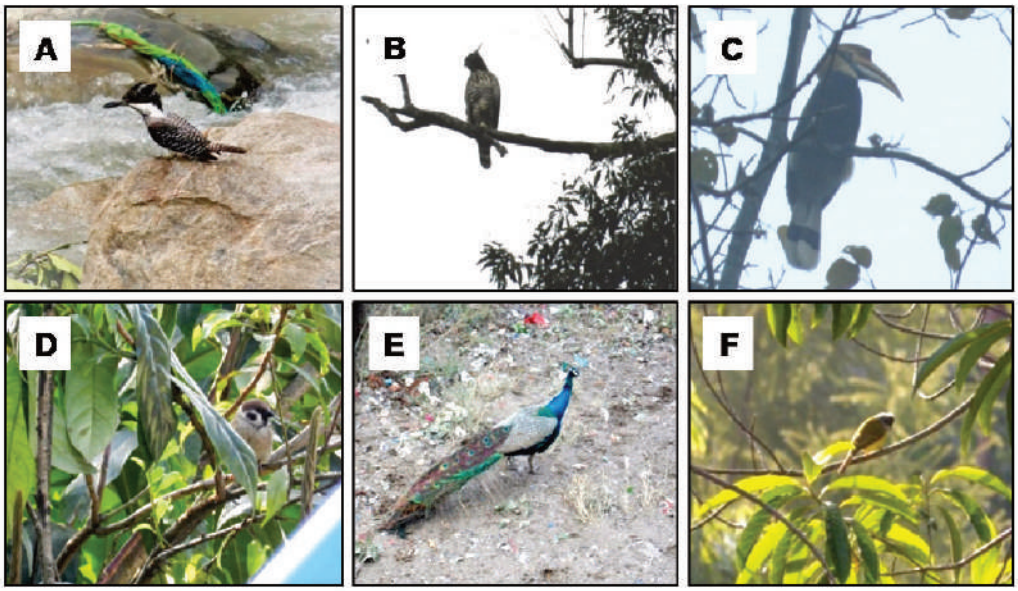

Figure 4: Representative pictures of birds observed in study sites. Here, A- Crested Kingfisher, B- Mountain Hawk-Eagle, C- Great Hornbill, D- Eurasian Tree Sparrow, E-Indian Peafowl and F- Grey-Headed Canary Flycatcher.

Discussion

The study has reported 118 bird species in mid-altitude regions of Darjeeling hamlets. The increasing trend of forest ecosystems especially inclusion of young forest patches simultaneously helps to elevate bird diversity in a landscape (Hanle *et al.*, 2020). The study sites consist of three different habitats which have distinct topological properties. Latpanchar and Shivkhola have

satisfactory forest cover and intervened by regular tourism and logging industries. Alike them, Simring is completely encroached by active tea estate. All those habitats faces deforestation and change of old tree communities by younger trees. This could be a problem for such a great diversity as birds to get sufficient food and shelter for their sustenance. Birds of Muscicapidae are found to be predominant in these three habitats and from this results we can hypothesized that, the Muscicapidae are likely to be less susceptible under disturbing conditions. A previous study by Francis *et al.* (2010), shows that vocal frequency increasing in disturbed areas have significant effects on flycatchers (Muscicapidae) which can alter their reflect response. Although, the study area have increasing anthropogenic interventions but those hilly regions still have significantly lower bona-fide population pressures comparative to cities year around. Therefore, reduction of anthropogenic noise may act as a contributing factor behind the predominance of Muscicapidae birds. Besides these, food resources also have a significant role in inclination of Muscicapidae bird diversity. The birds of Muscicapidae are generally frugivorous and insectivorous, while the study sites contains different types of small berry bearing plants like *Lantana camara.*, *Fragaria vesca* etc., and its position in deep deciduous forest ensures a huge diversity of entomo-fauna. The avian study in Talamanca Mountain, a tropical cloud forest shows that the frugivorous birds have potential tolerance power against the anthropogenic disturbances (Gomes *et al.*, 2008) which is quite similar to the above mentioned hypothesis.

In global scale, the tree canopy height has no direct link with avian diversity. It is may be a secondary factor over changing tree-tire wise species diversity but there should be other significant influencing factors (Roll *et al.*, 2015).On the other hand, the work of Hinsley *et al.* (2009) hypothesized that the difference of bird diversity across tree height was also related with canopy cover. According to their study, choice behind the selection of lower tree height by birds has strong correlation with the choice of low canopy cover and vice-versa. As this study categorizes the tree height specific bird species abundance therefore it can be possible that encountering of the bird on a particular tree

height is depending on individual bird species along with their preference over canopy cover. Not only birds are able to select the canopy cover but also they nurture and modulate them. A study on pheasant shows that they can regulate the canopy cover and helps in development of understory vegetation (Draycott *et al.*, 2008) in newly planted forests. Thus, the results of the study shows the habitat wise bird diversity in three different regions of Darjeeling along with the predominance of birds in spatial as well as tree height scale. The annotated checklist of observed birds may contribute as a basic knowledge base for future avifauna related studies regarding Darjeeling Himalayas.

Furthermore, irrespective of huge anthropogenic pressure like eco-tourism, uncontrolled home stay development, observers encountered a significant amount of bird species in all three areas during study. This will be a prominent signal behind the increment of disturbance tolerance ability among the hill-birds of those areas. So, it is needed that a sustainable coexistence between birds and humans should get equally promoted via more eco-friendly, non-invasive livelihood programs.

Conclusion

Any study of ecology is non-conclusive, as ecosystem is a very dynamic topic. The biodiversity is also dependent on various matters like- natural calamities, anthropogenic nuisance, etc. But this baseline study can give a proper documentation of Darjeeling Himalayan birds of winter season. The study indicates the bird based eco-tourism in the area where local people can sustain their livelihood apart from the agrarian economy. The home-stay tourism business with eco-guides will flourish in the light of birding in a controlled manner and thereby the holistic growth in biodiversity awareness and sustainable livelihood goal will be achieved hopefully in near future.

Acknowledgments

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Conflict of Interest

There is no conflict of interest among the authors, all authors contributed equally in this manuscript preparation.

Table 1: Annotated Checklist of avian diversity of three selected study area of Darjeeling Himalayan Hamlets, West Bengal, India.

Sl. No.	Order	Family (with codes)	Common Name	Scientific Name	IUCN Red List Category	WPA, 1972 Status	LTPN	SVKL	SMTE
1	Galliformes	Phasianidae (PH)	Indian Peafowl	*Pavo cristatus* Linnaeus, 1758	LC	Sch I	N	N	Y
2	Columbiformes	Columbidae (CO)	Rock Pigeon	*Columba livia* J.F. Gmelin, 1789	LC	NL	Y	Y	Y
3			Spotted Dove	*Streptopelia chinensis* (Scopoli, 1786)	LC	Sch IV	Y	Y	N
4			Oriental Turtle Dove	*Streptopelia orientalis* (Latham, 1790)	LC	Sch IV	Y	N	Y
5			Eurasian Collared Dove	*Streptopelia decaocto* (Frivaldszky, 1838)	LC	Sch IV	Y	N	Y
6			Pin-tailed Green Pigeon	*Treron apicauda* Blyth, 1846	LC	Sch IV	N	Y	N

16	15	14	13	12	11	10	9	8	7
Accipitriformes		Cuculiformes			Caprimulgiformes				
Accipitridae (AC)		Cuculidae (CU)			Apodidae (AP)	Podargidae (PO)			
Black Eagle	Himalayan Vulture	Green-billed Malkoha	Greater Coucal	Lesser Coucal	Little Swift	Hodgson's Frogmouth	Barred Cuckoo Dove	Mountain Imperial Pigeon	Wedge-tailed Green Pigeon
Ictinaetus malaiensis (Temminck, 1822)	*Gyps himalayensis* Hume, 1869	*Phaenicophaeus tristis* (Lesson, 1830)	*Centropus sinensis* (Stephens, 1815)	*Centropus bengalensis* (J.F. Gmelin, 1788)	*Apus affinis* (J.E. Gray, 1830)	*Batrachostomus hodgsoni* (G.R. Gray, 1859)	*Macropygia unchall* (Wagler, 1827)	*Ducula badia* (Raffles, 1822)	*Treron sphenurus* (Vigors, 1832)
LC	NT	LC	LC	LC	LC	LC	LC	LC	LC
Sch I	Sch IV	Sch IV	Sch IV	Sch IV	Sch IV	Sch I	Sch IV	Sch IV	Sch IV
Y	Y	N	Y	Y	Y	Y	Y	Y	Y
N	N	Y	N	N	Y	N	Y	Y	Y
Y	N	N	N	N	N	N	N	Y	N

26	25	24	23	22	21	20	19	18	17
Bucerotiformes		Trogoniformes	Strigiformes						
Bucerotidae (BU)		Trogonidae (TR)	Strigidae (ST)			Crested Serpent Eagle	Oriental Honey Buzzard	Black Baza	Mountain Hawk Eagle
Great Hornbill	Rufous-necked Hornbill	Red-headed Trogon	Spotted Owlet	Asian Barred Owlet	Mountain Scops Owl	*Spilornis cheela* (Latham, 1790)	*Pernis ptilorhynchus* (Temminck, 1821)	*Aviceda leuphotes* (Dumont, 1820)	*Nisaetus nipalensis* Hodgson, 1836
Buceros bicornis Linnaeus, 1758	*Aceros nipalensis* (Hodgson, 1829)	*Harpactes erythrocephalus* (Gould, 1834)	*Athene brama* (Temminck, 1821)	*Glaucidium cuculoides* (Vigors, 1831)	*Otus spilocephalus* (Blyth, 1846)				
VU	VU	LC	LC	LC	LC	LC	LC	LC	LC
Sch I	Sch I	Sch IV	Sch IV	Sch IV	Sch IV	Sch I	Sch I	Sch I	Sch I
Y	Y	Y	N	Y	Y	Y	Y	Y	Y
N	N	N	N	N	N	Y	N	N	N
N	N	N	Y	N	Y	N	N	N	N

34	33	32	31	30	29	28	27
Piciformes							
Ramphastidae (RA)			Picidae (PI)				
Blue-eared Barbet	Great Barbet	Blue-throated Barbet	Greater Yellow-naped Woodpecker	Greater Golden-backed Woodpecker	Darjeeling Woodpecker	Bay Woodpecker	Lesser Yellow-naped Woodpecker
Psilopogon australis (Horsfield, 1821)	*Psilopogon virens* (Boddaert, 1783)	*Psilopogon asiaticus* (Latham, 1790)	*Chrysophlegma flavinucha* (Gould, 1834)	*Chrysocolaptes lucidus* (Scopoli, 1786)	*Dendrocopos darjellensis* (Blyth, 1845)	*Blythipicus pyrrhotis* (Hodgson, 1837)	*Picus chlorolophus* Vieillot, 1818
LC	LC	LC	LC	LC	LC	LC	LC
Sch IV	Sch IV	Sch IV	Sch IV	Sch IV	Sch IV	Sch IV	Sch IV
Y	Y	Y	Y	Y	Y	Y	Y
N	N	Y	N	N	N	N	N
N	Y	N	N	N	N	N	Y

| 35 | | |

52	51	50	49	48	47	46	45	44	43
	Corvidae (CV)	Laniidae (LA)			Rhipiduridae (RH)	Dicruridae (DI)			
Grey Treepie	Rufous Treepie	Long-tailed Shrike	Grey-backed Shrike	Brown–backed Shrike	White-throated Fantail	Ashy Drongo	Lesser Racket-tailed Drongo	Spangled Drongo	Black Drongo
Dendrocitta formosae Swinhoe, 1863	*Dendrocitta vagabunda* (Latham, 1790)	*Lanius schach* Linnaeus, 1758	*Lanius tephronotus* (Vigors, 1831)	*Lanius cristatus* Linnaeus, 1758	*Rhipidura albicollis* (Vieillot, 1818)	*Dicrurus leucophaeus* Vieillot, 1817	*Dicrurus remifer* (Temminck, 1823)	*Dicrurus hottentottus* (Linnaeus, 1766)	*Dicrurus macrocercus* Vieillot, 1817
LC	LC	LC	LC	LC	LC	LC	LC	LC	LC
Sch IV	Sch IV	Sch IV	Sch IV	Sch IV	Sch IV	Sch IV	Sch IV	Sch IV	Sch IV
Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Y	Y	N	Y	Y	Y	Y	N	Y	Y
N	N	Y	Y	Y	N	N	Y	Y	Y

61		60	59	58	57	56	55	54	53
	Nectariniidae (NE)					Dicaeidae (DC)			
Mrs Gould's Sunbird		Fire-tailed Sunbird	Crimson Sunbird	Little Spiderhunter	Streaked Spiderhunter	Fire-breasted Flowerpecker	Red-billed Blue Magpie	Large-billed Crow	Common Green Magpie
Aethopyga gouldiae (Vigors, 1831)		*Aethopyga ignicauda* (Hodgson, 1836)	*Aethopyga siparaja* (Raffles, 1822)	*Arachnothera longirostra* (Latham, 1790)	*Arachnothera magna* (Hodgson, 1836)	*Dicaeum ignipectus* (Blyth, 1843)	*Urocissa erythrorycha* (Boddaert, 1783)	*Corvus macrorhynchos* Wagler, 1827	*Cissa chinensis* (Boddaert, 1783)
LC		LC	LC	LC	LC	LC	LC	LC	LC
Sch IV		Sch IV	Sch IV	Sch IV	Sch IV	Sch IV	Sch IV	Sch IV	Sch IV
Y		Y	Y	Y	Y	Y	N	Y	Y
Y		Y	Y	N	Y	N	Y	N	Y
N		N	N	Y	Y	N	N	Y	Y

71	70	69	68	67	66	65	64	63	62
Paridae (PD)		Stenostiridae (SS)	Emberizidae (EM)	Fringillidae (FR)	Passeridae (PA)	Prunellidae (PR)	Irenidae (IR)		
Black-lored Tit	Sultan Tit	Grey-headed Canary-flycatcher	Black-headed Bunting	Dark-rumped Rosefinch	Eurasian Tree Sparrow	Maroon-backed Accentor	Asian fairy-bluebird	Orange-bellied Leafbird	Black-throated Sunbird
Machlolophus xanthogenys (Vigors, 1831)	*Melanochlora sultanea* (Hodgson, 1837)	*Culicicapa ceylonensis* (Swainson, 1820)	*Granativora melanocephala* (Scopoli, 1769)	*Carpodacus edwardsii* J. Verreaux, 1871	*Passer montanus* (Linnaeus, 1758)	*Prunella immaculata* (Hodgson, 1845)	*Irena puella* (Latham, 1790)	*Chloropsis hardwickii* Jardine & Selby, 1830	*Aethopyga saturata* (Hodgson, 1836)
LC	LC	LC	LC	LC	LC	LC	LC	LC	LC
Sch IV	Sch IV	Sch IV	Sch IV	Sch IV	Sch IV	Sch IV	Sch IV	Sch IV	Sch IV
Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
N	N	N	N	N	Y	N	N	Y	N
N	Y	N	N	N	Y	N	N	N	N

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88	87	86	85	84	83	82	81
		Zosteropidae (ZS)			Aegithalidae (AG)		
Timaliidae (TL)		Black-chinned Yuhina	Whiskered Yuhina	Oriental White-eye	Black-throated Tit	Grey-hooded Leaf Warbler	Blyth's Leaf Warbler
White-browed Scimitar Babbler	Streak-breasted Scimitar Babbler	*Yuhina castaniceps* (F.Moore, 1854)	*Yuhina flavicollis* Hodgson, 1836	*Zosterops palpebrosus* (Temminck, 1824)	*Aegithalos concinnus* (Gould, 1855)	*Seicercus xanthoschistos* (J.E. & G.R. Gray, 1847)	*Seicercus reguloides* (Blyth, 1842)
Pomatorhinus schisticeps Hodgson, 1836	*Pomatorhinus ruficollis* Hodgson, 1836	LC	LC	LC	LC	LC	LC
LC	LC	Sch IV	Sch IV	Sch IV	Sch IV	Sch IV	Sch IV
Sch IV	Sch IV	Y	Y	Y	Y	Y	Y
Y	Y	N	N	N	N	N	N
Y	Y	N	N	N	N	N	N
Y	Y	N	N	N	N	N	N

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97			Sturnidae (SN)	Common Myna	*Acridotheres tristis* (Linnaeus, 1766)	LC	Sch IV	Y	Y	N
98				Hill Myna	*Gracula religiosa* Linnaeus, 1758	LC	Sch I	Y	Y	N
99				Chestnut-tailed Starling	*Sturnia malabarica* (J. F. Gmelin, 1789)	LC	Sch IV	Y	N	N
100			Muscicapidae (MC)	Oriental Magpie Robin	*Copsychus saularis* (Linnaeus, 1758)	LC	Sch IV	Y	Y	N
101				Blue Rock Thrush	*Monticola solitarius* (Linnaeus, 1758)	LC	Sch IV	Y	N	N
102				Blue Whistling Thrush	*Myophonus caeruleus* (Scopoli, 1786)	LC	Sch IV	Y	N	N
103				Blue-throated Flycatcher	*Cyornis rubeculoides* (Vigors, 1831)	LC	Sch IV	Y	Y	N
104				Taiga Flycatcher	*Ficedula albicilla* (Pallas, 1811)	LC	Sch IV	Y	N	N
105				Slaty-backed Flycatcher	*Ficedula sordida* (Godwin-Austen, 1874)	LC	Sch IV	Y	Y	N

106			Sapphire Flycatcher	*Ficedula sapphira* (Blyth, 1843)	LC	LC	Sch IV	Y	Y	Y
107			Plumbeous Water Redstart	*Rhyacornis fuliginosa* (Vigors, 1831)	LC	Sch IV	Sch IV	N	Y	N
108			Verditer Flycatcher	*Eumyias thalassinus* (Swainson, 1838)	LC	Sch IV	Sch IV	Y	Y	Y
109			Little Forktail	*Enicurus scouleri* Vigors, 1832	LC	Sch IV	Sch IV	Y	Y	Y
110			Slaty-backed Forktail	*Enicurus schistaceus* (Hodgson, 1836)	LC	Sch IV	Sch IV	Y	Y	N
111			Small Niltava	*Niltava macgrigoriae* (E. Burton, 1836)	LC	Sch IV	Sch IV	Y	N	N
112			Large Niltava	*Niltava grandis* (Blyth, 1842)	LC	Sch IV	Sch IV	Y	N	N
113			Daurian Redstart	*Phoenicurus auroreus* (Pallas, 1776)	LC	Sch IV	Sch IV	N	Y	N
114			White-capped Water Redstart	*Chaimarrornis leucocephalus* (Vigors, 1831)	LC	Sch IV	Sch IV	N	Y	N
115			Pied Bushchat	*Saxicola caprata* (Linnaeus, 1766)	LC	Sch IV	Sch IV	Y	N	N

116		Turdidae (TD)	Orange-headed Thrush	*Geokichla citrina* (Latham, 1790)	LC	Sch IV	Y	Y	N
117			Long-billed Thrush	*Zoothera monticola* Vigors, 1832	LC	Sch IV	Y	N	N
118			Himalayan Thrush	*Zoothera salimalii (Alstrom et al., 2016)*	LC	Sch IV	Y	N	Y

Abbreviations: IUCN- International Union for Conservation of Nature and Natural Resources; WPA, 1972- Indian Wildlife (Protection) Act, 1972; LC- Least Concerned; VU- Vulnerable; NT-Near Threatened; Sch I- Schedule I; Sch IV- Schedule IV; NL- Not Listed., LTPN- Latpanchar, SVKL- Shivkhola, SMTE- Simring Tea Estate. Y-Yes/Present; N- No/Absent

Table 2: Relative Diversity index (RDi) of the representative families of birds of three sampling area.

Sl. No	Family Codes	No. of Representative Species	RDi Value
1.	MC	15	13.392
2.	CO	8	7.142
3.	AC, NE, LD	6	5.357
4.	PI, CV	5	4.464
5.	ST, DI, PY	4	3.571
6.	CU, RA, PC, ZS, SN	3	2.678
7.	BU, ME, AL, LA, PD, HI, SD, TD	2	1.785
8.	PH, PO, AP, TR, FA, PS, CA, OR, RH, DC, IR, PR, PA, FR, EM, SS, AG, TL, EU	1	0.892

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